

AMENDMENTS TO THE CLAIMS

This listing of claims replaces all prior versions, and listings, of claims in the application:

1. (currently amended): A hydraulic control system for a belt-drive continuously variable transmission (CVT) of a vehicle, the CVT including a belt, the hydraulic control system comprising:

an oil pump operative to produce an oil pressure and an oil flow amount which are supplied to the CVT;

a pressure regulator valve operative to regulate the oil pressure produced by the oil pump;

a belt lubricating oil supply passage for supplying oil to the belt on a downstream side of the pressure regulator valve;

engine operating condition detecting means for detecting an engine operating condition and ~~generating a signal indicative of the an engine operating condition detected~~ signal, the engine operating condition detecting means including an oil temperature sensor operative to:

detect a temperature of the oil in the CVT; and

generate an oil temperature signal indicative of the oil temperature detected;

an oil cooler disposed on a downstream side of the pressure regulator valve;

a lubricating oil supply path for supplying the oil to lubrication parts in the CVT, the lubricating oil supply path being disposed on a downstream side of the oil cooler and including the belt lubricating oil supply passage;

line pressure detecting means for:

detecting a line pressure between the oil pump and the pressure regulator valve; and

generating a line pressure signal indicative of the line pressure detected; and

a controller for controlling the oil flow amount based on the engine operating condition signal, which is generated based on the oil temperature signal and the line pressure signal, the controller being programmed to:

calculate a CVT input torque based on the engine operating condition signal;

calculate a required belt lubricating oil flow amount to be supplied to the belt on the basis of the engine operating condition signal and the CVT input torque;

calculate a required cooler oil flow amount to be supplied to the oil cooler from the required belt lubricating oil flow amount on the basis of a predetermined oil distribution ratio of an oil flow amount to be supplied to the belt lubricating oil supply passage to an oil flow amount to be supplied to the lubricating oil supply path;

calculate a cooler input pressure required to supply the oil to the oil cooler on the basis of the required cooler oil flow amount;

determine a minimum speed of the oil pump based on the required belt lubricating oil flow amount; that is required to provide the cooler input pressure, on the basis of the oil temperature signal and the line pressure signal; and

control the oil pump at the minimum speed.

2. (cancelled).

3. (currently amended): The hydraulic control system as claimed in claim 1, wherein the engine operating condition detecting means comprises a throttle position sensor operative to detect a throttle opening degree and to generate a throttle opening degree signal indicative of the throttle opening degree detected.

4. (currently amended): The hydraulic control system as claimed in ~~claim 2~~, claim 1,

wherein the CVT includes a primary pulley,

wherein the hydraulic control system further comprising comprises:

primary pulley speed detecting ~~means for~~ means for:

detecting rotational speed of the primary ~~pulley and~~ pulley; and

generating a primary pulley speed signal indicative of the rotational speed detected,

wherein the controller is configured to receive ~~receiving~~ the primary pulley speed signal, and

wherein the controller is being ~~is being~~ programmed to calculate the required belt lubricating oil flow amount based on at least one of the CVT input torque and the primary pulley speed signal when the oil temperature is not less than a predetermined value.

5. (currently amended): The hydraulic control system as claimed in claim 4,

wherein the CVT includes a secondary pulley,

wherein the hydraulic control system further comprising comprises:

secondary pulley speed detecting ~~means for~~ means for:

detecting rotational speed of the secondary ~~pulley and~~ pulley; and

generating a secondary pulley speed signal indicative of the rotational speed detected,

wherein the controller is configured to receive ~~receiving~~ the secondary pulley speed signal, and

wherein the controller is being ~~is being~~ programmed to:

calculate a pulley speed ratio between the rotational speed of the primary pulley and the rotational speed of the secondary pulley; and

calculate the required belt lubricating oil flow amount based on at least one of the CVT input torque, the primary pulley speed ~~signal and~~ signal, and the pulley speed ratio when the oil temperature is not less ~~than a~~ than the predetermined value.

6. (cancelled).

7. (currently amended): The hydraulic control system as claimed in claim 5, wherein the CVT has a manual transmission mode allowing to manually change the pulley speed ratio,

wherein the hydraulic control system further ~~comprising~~ comprises:

transmission mode detecting ~~means for~~ means for:

detecting that the CVT is in the manual transmission ~~mode~~ mode; and

generating a manual mode signal indicative of the CVT in the manual transmission mode, and

wherein the controller is being programmed, in response to the manual mode signal, to clear the minimum speed of the oil pump.

8. (currently amended): The hydraulic control system as claimed in claim 5, wherein the CVT has a manual transmission mode allowing to manually change the pulley speed ratio and an automatic transmission mode allowing to automatically change the pulley speed ratio,

wherein the hydraulic control system further ~~comprising~~ comprises:

transmission mode detecting ~~means for~~ means for:

detecting whether the CVT is in the manual transmission mode or in the automatic transmission ~~mode~~ mode; and

generating a manual mode signal indicative of the CVT in the manual transmission mode and an automatic mode signal indicative of the CVT in the automatic transmission mode, and

wherein the controller is being programmed, in response to the manual mode signal, to set the minimum speed of the oil pump larger than in the automatic transmission mode.

9. (currently amended): The hydraulic control system as claimed in claim 1, wherein the vehicle ~~includes~~ comprises:

an anti-lock brake system (ABS) actuator operative to control a braking ~~pressure,~~ pressure;

an ABS control unit for generating an ABS control signal to the ABS ~~actuator,~~ actuator; and

an ABS control sensor ~~operative to~~ operative to:

detect the ABS control ~~signal~~ signal; and

generate an ABS control ON signal indicative of ABS control being conducted, and

wherein the controller is being programmed, in response to the ABS control ON signal, to clear the minimum speed of the oil pump.

10. (currently amended): The hydraulic control system as claimed in ~~claim 6,~~ claim 1,

wherein the belt lubricating oil supply passage comprises a belt lubricating nozzle for injecting the oil to the belt, and

wherein the lubricating oil supply path comprises ~~comprising~~ a gear lubricating nozzle for injecting the oil to a differential gear.

11. (currently amended): A method for controlling a belt-drive continuously variable transmission (CVT) of a vehicle, the CVT including a belt, the vehicle including an oil pump operative to produce an oil pressure and an oil flow amount which are supplied to the CVT, a pressure regulator valve operative to regulate the oil pressure produced by the oil pump, ~~and a belt lubricating oil supply passage for supplying oil to the belt on a downstream side of the pressure regulator valve, an oil cooler disposed on the downstream side of the pressure regulator valve, and a lubricating oil supply path for supplying the oil to lubrication parts in the CVT, the lubricating oil supply path being disposed on a downstream side of the oil cooler and including the belt lubricating oil supply passage,~~ the method comprising:

generating an engine operating condition signal indicative of an engine operating condition, the engine operating condition signal being based on an oil temperature signal indicative of a temperature of the oil in the CVT and a line pressure signal indicative of a line pressure between the oil pump and the pressure regulator valve;

calculating a CVT input torque based on the engine operating condition signal;

calculating a required belt lubricating oil flow amount to be supplied to the belt on the basis of the engine operating condition signal and the CVT input torque;

calculating a required cooler oil flow amount to be supplied to the oil cooler from the required belt lubricating oil flow amount on the basis of a predetermined oil distribution ratio of an oil flow amount to be supplied to the belt lubricating oil supply passage to an oil flow amount to be supplied to the lubricating oil supply path;

calculating a cooler input pressure required to supply the oil to the oil cooler on the basis of the required cooler oil flow amount;

determining a minimum speed of the oil pump ~~based on the required belt lubricating oil flow amount;~~ that is required to provide the cooler input pressure, on the basis of the oil temperature signal and the line pressure signal; and

controlling the oil pump at the minimum speed.

12. (cancelled).

13. (currently amended): The method as claimed in claim 11,
wherein the engine operating condition signal comprises a throttle opening degree
signal, and

wherein the CVT input torque is being calculated based on the throttle opening degree
signal.

14. (currently amended): The method as claimed in ~~claimed 12,~~ claim 11,
wherein the CVT includes a primary pulley, and
wherein the method further ~~comprising~~ comprises:

generating a primary pulley speed signal indicative of a rotational speed of the
primary ~~pulley,~~ pulley;

calculating the required belt lubricating oil flow amount based on at least one
of the CVT input torque and the primary pulley speed signal when the
oil temperature is not less than a predetermined value.

15. (currently amended): The method as claimed in claim 14,
wherein the CVT includes a secondary pulley, and
wherein the method further ~~comprising~~ comprises:

generating a secondary pulley speed signal indicative of a rotational speed of
the secondary pulley;

calculating a pulley speed ratio between the rotational speed of the primary
pulley and the rotational speed of the secondary pulley; and

calculating the required belt lubricating oil flow amount based on at least one
of the CVT input torque, the primary pulley speed ~~signal and~~ signal,
and the pulley speed ratio when the oil temperature is not less ~~than a~~
than the predetermined value.

16. (cancelled).

17. (currently amended): The method as claimed in claim 15,
wherein the CVT has a manual transmission mode allowing to manually change the
pulley speed ratio, and

wherein the method further-comprising comprises:

generating a manual mode signal indicative of the CVT in the manual
transmission mode; and
clearing, in response to the manual mode signal, the minimum speed of the oil
pump.

18. (currently amended): The method as claimed in claim 15,
wherein the CVT has a manual transmission mode allowing to manually change the
pulley speed ratio and an automatic transmission mode allowing to
automatically change the pulley speed ratio, and

wherein the method further-comprising comprises:

generating a manual mode signal indicative of the CVT in the manual
transmission mode and an automatic mode signal indicative of the
CVT in the automatic transmission mode; and
setting, in response to the manual mode signal, the minimum speed of the oil
pump larger than in the automatic transmission mode.

19. (currently amended): The method as claimed in claim 11,
wherein the vehicle includes an anti-lock brake system (ABS) actuator operative to
control a braking pressure and an ABS control unit for generating an ABS control signal to
the ABS actuator, and

wherein the method further-comprising comprises:

generating an ABS control ON signal indicative of ABS control being
conducted; and
in response to the ABS control ON signal, clearing the minimum speed of the
oil pump.

20. (currently amended): The method as claimed in ~~claim 16~~, claim 11,
wherein the belt lubricating oil supply passage comprises a belt lubricating nozzle for
injecting the oil to the belt, and
wherein the lubricating oil supply path comprises ~~comprising~~ a gear lubricating
nozzle for injecting the oil to a differential gear.